REMARKS/ARGUMENTS

Reconsideration and allowance of this application are respectfully requested. Currently, claims 9-10, 12-15, 19-29, 31-33 and 35-37 are pending in this application.

Allowable Subject Matter:

Applicant notes with appreciation the indication that claims 35-37 would be allowable if re-written in independent form. While claims 35-37 have been amended, Applicant submits that these claims still present allowable subject matter.

Rejections under 35 U.S.C. §103:

Claims 9-10, 26-29 and 31-33 were rejected under 35 U.S.C. §103 as allegedly being unpatentable over the three-way combination of Gupta (U.S. '359) and Bona (U.S. '049) and further in view of Glebov (U.S. '508). Applicant traverses this rejection.

In order to establish a *prima facie* case of obviousness, all the claim limitations must be taught or suggested by the prior art. The combination of Gupta, Bona and Glebov fails to teach or suggest all the claim limitations. For example, the combination fails to teach or suggest "wherein at least the optoelectronic device has added thereto a dielectric spacing layer, additional to the optoelectronic device, which enables electrical contact to be made to the optoelectronic device, and determines the distance from the bonding surface to the optical axis for the first component, when mounted on the shared substrate, to achieve said optical coupling in use, said spacing layer comprising a glass material having both organic and inorganic components," as required by independent claim 9 and its dependents.

Claim 9 requires the addition of a dielectric spacing layer to an existing optoelectronic device which is then flip chip mounted onto a substrate shared with another optical device. Nothing in any of Gupta, Bona and Glebov shows a dielectric spacing layer added to an existing

optoelectronic device and then flip chip mounted. All the layers shown in Gupta, Bona and Glebov are either part of the optoelectronic device, as cladding or optical layers, for example, or are provided via the substrate. The combination of Gupta, Bona and Glebov does not approach the idea of modifying an existing device so that it can be fitted to a separately developed and designed fabrication and assembly process.

Any layer of a device which is subsequently flip chip mounted may also act as a spacer layer. However, those layers are, in every case in Gupta, Bona and Glebov, present within the structure of the optoelectronic device. Example embodiments of claim 9 concern a complete, functional optoelectronic device which could be electrically driven to provide its optoelectronic function, which then has an additional layer outside the optoelectronic device structure. The optoelectronic device necessarily, for example, already has electrical contacts in one form or another. This complete, functional optoelectronic device then has another layer added, regardless of the existing arrangements for providing electrical drive to the device. This further layer is dielectric, to allow electrical drive still to be provided as necessary. This further layer can be added at any time after the complete, functional optoelectronic device has been made, but before it is flip chip mounted onto the shared substrate.

One of ordinary skill in the art would not have found it obvious to add a layer in this way, to an existing optoelectronic component, because these components have specific mechanical and temperature-related requirements. The use of the hybrid glass material, as also specified in claim 9, allows those requirements to be met during addition of the layer, for a range of different components, because of the flexibility in characteristics of the glass. Accordingly, optoelectronic devices can be manufactured quite separately, indeed bought in from different

suppliers, and can be assembled onto the same shared substrate, in optical alignment, either with each other or with other devices.

Each and every one of Gupta, Bona and Glebov concerns a single fabrication process in which devices are made in a single set of fabrication steps. Optoelectronic devices may be flip chip mounted into optical alignment, but they are designed and fabricated together with the rest of the relevant assembly and not one of them carries an extra layer, additional to both the structure and the functions of the optoelectronic device.

Claim 9 (as amended) specifies that the first component is an optoelectronic device which has been flip chip mounted onto a shared substrate. A dielectric spacing layer, additional to the optoelectronic device, has been added to the optoelectronic device. The dielectric spacing layer <u>enables electrical contact</u> to be made. Because the material has to be suitable in a wide range of circumstances, and in particular for tailoring its properties so as to convert a wide range of different optoelectronic devices for use in existing assemblies, the material comprises <u>a glass material having both organic and inorganic components</u>.

The three references relied primarily upon in the Office Action will now be discussed in turn.

Gupta discloses:

Figure 3 – a laser diode grown epitaxially in situ on the substrate. See column 3, lines 28-36:

> *"A layered laser diode structure 32 is formed on a surface 34 of the substrate 30. Preferably, the laser diode structure is formed by epitaxially forming a plurality of layers of semiconductor material on the substrate, the layers having relatively different impurity types and concentrations. The laser diode structure layers can be grown by well known methods such as metalo-organic chemical vapor deposition or molecular beam epitaxy."*

Figure 4 – the laser diode layers are then etched to give a mounting surface, and accurate positioning for a waveguide. See column 3, lines 52 to 58:

> *"As shown in Figure 4, a second mirrored surface is formed while removing a carefully controlled portion of the laser diode structure by etching the structure for a predetermined time to produce a waveguide mounting surface 54 on the substrate 30 that is diplaced by an accurately known distance X from the light emitting region of the laser diode."*

Figure 5 – a waveguide is mounted, waveguide down, onto a buffer layer which is added to the etched surface so as to be aligned with the laser diode. (The waveguide is not an optoelectronic device as there is no electrical supply to it.) See passage bridging columns 3 and 4:

> *"Preferably, as shown in FIG. 5, a buffer layer 51 such as a layer of oxide is formed on the surface 34 and a waveguide structure 53, such as a thin film waveguide formed on a lithium tantalate ($LiTaO_3$) substrate 55 is mounted, waveguide down, on the surface 30 or on the buffer layer.*

In the above passages, there is no opto-electronic device being flip chip mounted and the positioning of the waveguide for alignment is adjusted by a layer on the substrate, if at all, and not on the device being flip chip mounted. It is also stated (column 4, lines 15-24) that the laser diode can be grown onto the substrate while the position of the waveguide is masked. However, this is still an arrangement relying on the accuracy of epitaxial growth on the substrate to achieve alignment.

Figure 6 – the waveguide is now grown on the substrate and the laser diode is flip chip mounted. See column 4, lines 25-34. However, the overall process is all one process relying on conventional epitaxial growth and etching techniques <u>in relation to the substrate</u> to achieve optical alignment. There is never any question of the laser diode having to be additionally modified to get alignment and there is no extra layer added to the laser diode shown in Figure 6 or in any other of the figures. Col. 4, lines 25-34 states:

> *"In accordance with an alternative embodiment of this invention, as shown in FIG. 6, the elements are essentially reversed. A waveguide 60 is formed by conventional means on $LiNbO_3$ substrate 62. The surface 64 of the waveguide is masked and etched to form a recess 66. A previously constructed laser diode is placed on the etched surface 68 of the substrate in the recess 66 adjacent the waveguide, so that the light emitting layer of the laser diode is vertically aligned with the waveguide."*

This is just a variation of what was previously described, with all alignment being achieved via growth on the substrate and an otherwise integrated process.

Bona discloses:

Figure 8 – no flip chip mounted devices at all. Bona does discuss alignment involving cladding layers in relation to Figure 8 but in terms of mode cross section in order to achieve good coupling. This cannot be achieved by the thickness of a simple layer as claim 9, and Bona is not helpful at all in leading one of ordinary skill towards claim 9. For example, column 6, lines 49 to 65 of Bona states:

> *"The sketch FIG. 8B shows the alignment of the waveguide core 81 (dashed lines) to the light mode region 85 of the active layer 78.*
> *A schematic cross-sectional view of the waveguide shown in FIGS. 8, is illustrated in FIG. 9. Intensity contours of the fundamental mode of the external dielectric layer waveguide are shown as ellipsoide concentric regions. The refractive indices n_1 n_2, n_3 are chosen such that $n_1 \approx n_3$ and $\Delta n_w = n_2 - n_1$ is nearly equal to Δn_L of the laser waveguide to achieve nearly the same mode cross-sections in the laser waveguide and the external waveguide. The Full Width at Half Maximum of the calculated laser mode and of the mode sustained by the external passive waveguide can be made the same within 5 %. Therefore a good coupling of the laser light into the waveguide is given."*

Bona relies on a similarity of intensity contours of the modes in a laser waveguide and an external waveguide. This is a product of the very special manner in which the Bona assembly is fabricated and would not lend itself at all to simply adding a spacing layer. One of ordinary skill would not think of adding the special technique of Bona, which does not relate to flip chip mounting (and thus teaches away from any proposed combination arriving at claim 9) and could

not be transferred to it, to the Gupta arrangement and it would not approach claim 9 even if one of ordinary skill did.

Glebov discloses:

Figure 9D – a process for assembling two electro-optic devices onto a substrate in alignment with a slab waveguide present on the substrate. The process for fabricating assemblies according to Glebov is also set out in Figures 10 and 11. There is never any question of modifying an optoelectronic device by adding an extra layer in the manner of the applicant's invention. Primarily, epitaxial techniques are used. Flip chip mounting is just used with the electro-optic devices and is described as follows from col. 10, lines 20-67, with "ML" standing for micro-lens and "EO" standing for electro-optic.

> *"The block 240 with the EO film 238 is assembled up side down on the substrate 220 with ML's and slab waveguide as shown in the side view in FIG. 9D. The top surface of the EO film 238 is patterned with metal electrodes having a prism shape as was shown in previous figures. The wiring with wiring contact pads can be formed on the substrate 220. The EO film block 240 is attached to the substrate 220 and the prism electrodes on the surface of the EO film are contacted to the wiring lines which are formed on the substrate. Electrical contact from the prisms to the wiring lines as well as attachment can be realized by flip chip bonding using solder bumps. This technique is well established in semiconductor and optical industry. Solder bumps (circles 270 between the substrate 220 and the EO block 240) are schematically shown in FIG. 9D. Besides solder bumps 270, the EO block 240 can be attached to the substrate 220 by any other method appropriate in this device structure."*

Although it is acknowledged in Glebov that there is a need for accurate alignment, the whole fabrication process is set out as a unified set of consecutive steps. There is never any need for adding a layer to any complete and previously fabricated device to make it align because the process is set out in full from the beginning to the end. All dimensions will be chosen appropriately. The flip chip mounted devices are blocks 240 with a three-layer EO film 238 on one face. These films provide three layers, lower cladding 244, core 246 and upper cladding

248. These three layers are all part of the functioning of the EO device and there are no additional layers for alignment purposes only. There would never be a need in the Glebov assembly as it is all one, continuous, planned fabrication process.

Applicant therefore requests that the rejection under 35 U.S.C. §103 over Gupta, Bona and Glebov be withdrawn.

Claims 12-13 and 35-37 were rejected under 35 U.S.C. §103 as allegedly being unpatentable over the four-way combination of Gupta, Bona and Glebov, and further in view of Tada (U.S. '902). Claims 14-15 were rejected under 35 U.S.C. §103 as allegedly being unpatentable over the four-way combination of Gupta, Bona and Glebov, and further in view of Blauvelt (U.S. '913). Claims 19-22, 24 and 25 were rejected under 35 U.S.C. §103 as allegedly being unpatentable over the four-way combination of Gupta, Bona and Glebov, and further in view of Nashimoto (U.S. '660). Claim 23 was rejected under 35 U.S.C. §103 as allegedly being unpatentable over the five-way combination of Gupta, Bona, Glebov and Nashimoto, and further in view of Kaneko. Each of these claims depends directly or indirectly from independent claim 9 and thus the comments made above with respect to at least Gupta, Bona and Glebov apply equally to these claims. Applicant submits that none of the additionally cited references (Tada, Blauvelt, Nashimoto or Kaneko) resolve the above-described deficiencies of the three-way combination of Gupta, Bona and Glebov. Applicant therefore requests that the various rejections under 35 U.S.C. §103 be withdrawn.

Conclusion:

Applicant believes that this entire application is in condition for allowance and respectfully requests a notice to this effect. If the Examiner has any questions or believes that an

interview would further prosecution of this application, the Examiner is invited to telephone the undersigned.

Respectfully submitted,

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